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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/652,786

08/29/2003

Dongshan Fu

007291.P029

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01/27/2006

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

EXAMINER

KAO, CHIH CHENG G

ART UNIT

PAPER NUMBER

2882

DATE MAILED: 01/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/652,786

Applicant(s)

FU ET AL.

Examiner

Chih-Cheng Glen Kao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 July 2005 and 27 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-49 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-20 is/are allowed.
- 6) ☒ Claim(s) 21, 23-25, 34, 38, 39, 44 and 45 is/are rejected.
- 7) ☒ Claim(s) 22, 26-33, 35-37, 40-43 and 46-49 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 March 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☒ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>7/14/05</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Oath/Declaration

1. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

The oath or declaration is defective because:

It fails to identify the mailing address of each inventor. A mailing address is an address at which an inventor customarily receives his or her mail and may be either a home or business address. The mailing address should include the ZIP Code designation. The mailing address may be provided in an application data sheet or a supplemental oath or declaration. See 37 CFR 1.63(c) and 37 CFR 1.76.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the claimed subject matter of claims 4 and 24 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the

drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. The amendment filed 7/14/05 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows.

Regarding (paragraph 29, line 2, "and (r_B , ϕ_B)") and (paragraph 29, line 4, "and (r_B , ϕ_B)"), these recitations are located in a sentence that refers only to projection A, not projection B. These out-of-plane rotations, (r_B , ϕ_B), do not belong to projection A. Further evidence is shown in paragraph 27. Furthermore, these out-of-plane rotations, (r_B , ϕ_B), in relation to projection A were not recited in the original application. These objections may be obviated by deleting "and (r_B , ϕ_B)" in both lines.

Regarding (paragraph 37, line 4, "may be determined") and (paragraph 37, line 5, "may be generated"), these recitations are not recited in claims 4 or 24 or the original

application. These objections may be obviated by replacing “may be” with - -are-
- in both instances.

Regarding (paragraph 45, line 7, “The software”), these recitations are not recited in claims 4 or 24 or the original application. This objection may be obviated by replacing “software” with - -means- -.

Regarding (paragraph 45, line 8, “may be configured to”) and (paragraph 45, line 10, “may be configured to”), these recitations are not recited in claims 4 or 24 or the original application. These objections may be obviated by deleting “may be configured to” in both instances.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Objections

4. Claims 1, 21, 30, and 35 are objected to because of the following informalities, which appear to be minor draft errors including grammatical and lack of antecedent basis problems.

In the following format (location of objection; suggestion for correction; reason for problem if provided), the following suggestions may overcome their respective objections: (claim 1, line 29, “said parameters”; inserting - -in-plane and out-of-plane- - before “parameters”), (claim 21, line 17, “said 2D reconstructed images”; replacing “images” with - - image- -), (claim 30, line 2, “the in-plane rotation parameters”; replacing “parameters” with - - parameter- -; only one in-plane rotation parameter), and (claim 35, lines 1-2, “said means for performing a 1D search”; changing the dependency from claim 21 to claim 22).

For purposes of examination, the claims have been treated as such. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 38, 39, 44, and 45 are rejected under 35 U.S.C. 102(b) as being anticipated by Murphy et al. (US Patent 5901199).

6. Regarding claims 38 and 44, Murphy et al. discloses a method and system comprising acquiring x-ray images of a target volume in a first image plane and a second image plane (fig. 3, #42), the x-ray images defining a present orientation of the target volume (fig. 3, on #34), generating synthetic x-ray reference images (col. 4, lines 38-44) of the target volume from 3-dimensional scan data (col. 4, lines 23-37) representing a previous orientation of the target volume (col. 4, lines 24-26), the synthetic x-ray reference images corresponding to in-plane transformations and out-of-plane rotations of the target volume projected onto the first image plane and the second image plane (figs. 6 and 7), and determining a difference between the present orientation of the target volume and the previous orientation of the target volume in three translational coordinates and three rotational coordinates by comparing in-plane transformation

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parameters and out-of-plane rotation parameters of the x-ray images and the synthetic x-ray reference images in the first image plane and the second image plane (col. 5, lines 20-21).

7. Regarding claims 39 and 45, Murphy et al. further discloses wherein the in-plane transformation parameters comprise two in-plane translation parameters and one in-plane rotation parameter in each of the first image plane and the second image plane, and wherein the out-of-plane rotation parameters comprise two mutually orthogonal rotations with respect to each of the first image plane and the second image plane (figs. 6 and 7).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 21, 23-25, 34, 38, 39, 44, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schweikard et al. (US Patent Application Publication 2004/0092815) in view of Miller et al. (US Patent 5117829) and Murphy ("An automatic six-degree-of-freedom image registration algorithm for image-guided frameless stereotaxic radiosurgery").

9. Regarding claims 21, 38, 39, 44, and 45, Schweikard et al. discloses a system and method comprising means for providing 3D scan data of a target (paragraph 36), a radiation source for

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generating at least one radiographic imaging beam (Fig. 1, #32A, and paragraph 39), an imaging system for generating a 2D radiographic image (Fig. 1, #34, and paragraph 27) of a target in near real time (paragraph 24, lines 1-2), and means for generating at least one 2D reconstructed image, using a known angle of an imaging beam (paragraph 39, lines 3-6, and paragraph 45).

However, Schweikard et al. fails to disclose means for generating at least one reconstructed image, using a known angle, location, and intensity, and determination of a set of parameters (x , y , θ , r , and ϕ) representing a difference in the position of a target shown in a radiographic image as compared to a position of the target as shown by a reconstructed image.

Miller et al. teaches generating at least one reconstructed image, using a known angle, location, and intensity (col. 3, lines 50-66). Murphy teaches determination of a set of in-plane and out-of-plane parameters representing a difference in the position of a target shown in a radiographic image as compared to a position of the target as shown by a reconstructed image (abstract).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the system and method of Schweikard et al. with the known angle, location, and intensity of Miller et al., since one would be motivated to make such a modification to advantageously provide data for formulating a plan (col. 3, lines 45-46) as implied from Miller et al.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the system and method of Schweikard et al. with the determination of parameters of Murphy, since one would be motivated to make such a modification for greater accuracy (abstract) as implied from Murphy.

10. Regarding claim 23, Schweikard et al. further discloses an x-ray source (paragraph 27), a 2D x-ray image (paragraph 44), and a reconstructed image comprising a 2D DRR (paragraph 38, last 3 lines).

11. Regarding claims 24 and 25, Schweikard et al. further teaches equivalent means for determining a plurality of N_R and N_ϕ of out-of-plane rotation angles, respectively for said rotational parameters, generating a plurality of $N_R * N_\phi$ of 2D reference images, one reference image for each of said plurality N_R and N_ϕ of said out-of-plane rotation angles, and generating offline a plurality of in-plane rotated 2D references images by performing a series of in-plane rotations on said reconstructed image (paragraph 39).

12. Regarding claim 34, Schweikard et al. further discloses 3D scan data comprising at least one of CT scan data, MRI scan data, and PET data (Abstract, lines 11-13).

Allowable Subject Matter

13. Claims 1-20 contain allowable subject matter. Claims 22-33, 35-37, 40-43, and 46-49 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

14. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 1, prior art fails to disclose or fairly suggest a method including the steps of determining the value of in-plane transformation parameters (x, y, θ) and out-of-plane rotational parameters (r, ϕ) for registering a reconstructed image onto an x-ray image, said parameters representing a difference in position of a target as shown in said x-ray image, as compared to the position of the target as shown by said image reconstructed from 3D scan data, obtaining an initial estimate for in-plane transformation parameters (x, y, θ) by multi-level matching in three dimensions, between an x-ray image and a reconstructed image, based on parameters estimated in step a, performing an initial search in one dimension for each of the pair of out-of-plane rotation parameters (r, ϕ) , and iteratively refining said in-plane parameters (x, y, θ) and said out-of-plane parameters (r, ϕ) until said in-plane and out-of-plane parameters converge to a desired accuracy, in combination with all the limitations in the claim. Claims 2-19 contain allowable subject matter by virtue of their dependency.

Regarding claim 22, prior art fails to disclose or fairly suggest an apparatus including software for determining a set of in-plane transformation parameters (x, y, θ) and out-of-plane rotational parameters (r, ϕ) representing a difference in a position of a target as shown in a radiographic image as compared to the position of the target as shown by a 2D reconstructed image and for determining in-plane and out-of-plane rotational parameters comprising means for performing a 3D multi-level matching to determine an initial estimate for in-plane transformation parameters (x, y, θ) , means for performing a 1D search for each of the pair of out-of-plane rotation parameters (r, ϕ) based on initially estimated in-plane parameters (x, y, θ) , and means for iteratively refining said in-plane parameters (x, y, θ) and said out-of-plane parameters (r, ϕ) , until a

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desired accuracy is reached, in combination with all the limitations in the claim. Claims 26-33 and 35-37 contain allowable subject matter by virtue of their dependency.

Regarding claims 40 and 46, prior art fails to disclose or fairly suggest a method or system including estimating the in-plane transformation parameters in the first image plane and the second image plane using a plurality of in-plane rotated synthetic x-ray reference images, searching the in-plane transformation parameters in the first image plane and the second image plane using a first similarity measure between the x-ray images and the synthetic x-ray reference images in a 3-dimensional multi-level search, searching the out-of-plane rotation parameters in the first image plane and the second image plane in a 1-dimensional search using a second similarity measure between the x-ray images and the synthetic x-ray reference images, refining the in-plane translation parameters in the first image plane and the second image plane using z-dimensional sub-pixel matching between the x-ray images and the synthetic x-ray reference images, refining the in-plane rotation parameters in the first image plane and the second image plane using 1-dimensional interpolation based on the in-plane translation parameters and the out-of-plane rotation parameters, and refining the out-of-plane rotation parameters in the first image plane and the second image plane using a 1-dimensional search based on the refined in-plane translation and in-plane rotation parameters using the second similarity measure, in combination with all the limitations in each respective claim, intervening claim, and base claim. Claims 41-43 and 47-49 contain allowable subject matter by virtue of their dependency.

Response to Arguments

15. Applicant's arguments, see pages 22 and 23 in the Amendment filed 7/14/05, with respect to the rejection(s) of claim(s) 21, 23-25, and 34 under 35 U.S.C. 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Murphy. Additional arguments filed 7/14/05 have been fully considered but they are not persuasive.

16. Regarding the oath, Applicant argues that an oath and declaration with the mailing address of each inventor was filed on March 5, 2004. The Examiner disagrees. As seen on said oath and declaration, the Post Office Address (i.e. mailing address) is "Same as above" for Dongshan Fu, but was left blank for Gopinath Kuduvalli and Shehrzad Qureshi. Therefore, the oath or declaration remains objected to for being defective because it fails to identify the mailing address of each inventor.

17. Regarding objections to the drawings not showing every feature specified in claims 4 and 24, Applicant argues that at least step 130 in Figure 3 represents the features specified in claim 4, and controller 208 in Figure 5 represents claim 24. The Examiner disagrees with this logic for overcoming the objection. Although the step and controller that Applicant refers to may represent claims 4 and 24, they do not show the feature. The step 130 (i.e. "Out-of-plane rotation initial search using one-dimensional search") and controller 180 fail to show determining a plurality of N_R and N_ϕ of out-of-plane rotation angles, respectively for said rotational parameters, and generating a plurality of $N_R * N_\phi$ of 2D reference images, one reference

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image for each of said plurality N_R and N_ϕ of said out-of-plane rotation angles, as recited in claims 4 and 24. Therefore, the drawings remain objected to for not showing every feature specified in the claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chih-Cheng Glen Kao whose telephone number is (571) 272-2492. The examiner can normally be reached on M - F (9 am to 5 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ed Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



gk



EDWARD J. GLICK
SUPERVISORY PATENT EXAMINER